Special Civil Engineer Examination
Engineering Surveying Test Plan
Revised December 2005

Definition of Engineering Surveying

Engineering Surveying is defined as those activities involved in the practice and application of surveying principles for the location, design, construction and maintenance and operation of engineered projects.

This area of practice is structured into four primary content areas:

- **A.** Engineering Surveying Equipment and Field Activities (15%)
- **B.** Engineering Surveying Field Measurements (11%)
- **C.** Engineering Surveying Calculations (33%)
- **D.** Engineering Surveying Office Procedures (41%)

Glossary of Engineering Surveying Terms

As used in the test plan task statements, the following abilities are defined as:

Determine	To establish or define after consideration, investigation, or calculation for use in an engineering surveying activity.
Interpret	To conceive and explain the meaning of engineering surveying terms, symbols and procedures.
Perform	To execute and complete a task in accordance with the requirements of engineering surveying practice.
Prepare	To put together or make by combining various existing or newly created elements for use in an engineering surveying activity.
Recognize	To know or identify the engineering surveying elements of a project from past experience or knowledge.

A. ENGINEERING SURVEYING EQUIPMENT AND FIELD ACTIVITIES (15%)

Engineering surveying equipment and field activities include the types of equipment used and their application for gathering and interpreting field data and for construction layout.

T1. Recognize the purposes of different types of surveys.

K1. Knowledge of control surveys.
K2. Knowledge of construction surveys.
K3. Knowledge of route surveys.
K4. Knowledge of topographic surveys.
K5. Knowledge of boundary surveys.

T2. Recognize the field survey instruments and equipment required to perform engineering surveying measurements.

K6. Knowledge of engineer's transit.
K7. Knowledge of Total Station.
K8. Knowledge of leveling equipment.
K9. Knowledge of Global Positioning System (GPS).
K20. Knowledge of Electronic Distance Measurement (EDM).

T3. Recognize common construction surveying methods and procedures.

K10. Knowledge of the construction layout requirements.
K11. Knowledge of horizontal curve layout.
K12. Knowledge of horizontal and vertical control layout.
K13. Knowledge of line and grade layout.
K15. Knowledge of offset distance computations
K17. Knowledge of procedures for establishing points on a straight line.
K18. Knowledge of procedures for locating a single point.

B. ENGINEERING SURVEYING FIELD MEASUREMENTS (11%)

Engineering surveying field measurements include the methods and procedures for determining distances, angles and elevations.

T4. Perform the measurement of horizontal distances.

K19. Knowledge of measuring slope distances.

T5. Perform the measurement of angles.

K21. Knowledge of measuring horizontal angles.
K22. Knowledge of measuring deflection angles.
K23. Knowledge of measuring vertical angles.
K24. Knowledge of the relationships between azimuths, bearings, back bearings and angles.

T6. Perform the measurement of elevations.

K25. Knowledge of differential leveling.
K26. Knowledge of leveling terminology.
K27. Knowledge of trigonometric leveling.
K28. Knowledge of cross-section leveling.
K29. Knowledge of profile leveling.

C. ENGINEERING SURVEYING CALCULATIONS (33%)

Engineering surveying calculations are the analytical methods for applying the mathematical relationships between measured distances, angles and elevations.

T7. Perform basic geometric and trigonometric calculations.

K30. Knowledge of the properties of a right angle.
K31. Knowledge of general trigonometric formulas.
K32. Knowledge of the properties of an oblique triangle.
K33. Knowledge of trigonometric relationships to determine the area of a polygon.

T8. Determine the properties of a horizontal circular curve.

K34. Knowledge of the geometric properties and equations of a curve.
K35. Knowledge of curve deflections.
K36. Knowledge of procedures for locating a point on a curve.
K37. Knowledge of procedures for calculating stations for the point of intersection, beginning of curve and end of curve.
K38. Knowledge of properties of compound and reversing curves.
K39. Knowledge of procedures for calculating the intersection of a curve and a straight line.

T9. Determine the properties of a vertical curve.

K40. Knowledge of procedures for calculating a vertical curve.
K41. Knowledge of procedures for calculating vertical curves from tangent offsets of grade lines.
K42. Knowledge of procedures for calculating intermediate points.
K43. Knowledge of procedures for calculating the highest or lowest point.
K44. Knowledge of procedures for calculating the rate of gradient.
K45. Knowledge of procedures for calculating profile grade (slope) and elevations on the tangents.

T10. Perform leveling calculations from field data to determine elevations.

K46. Knowledge of procedures for running a line of levels.
K47. Knowledge of procedures for checking level notes.
K48. Knowledge of procedures for trigonometric leveling.
K49. Knowledge of procedures for profile leveling.

T11. Perform rectangular coordinate system calculations.

K51. Knowledge of procedures for calculating distances from coordinates.
K52. Knowledge of procedures for calculating bearings or azimuths from coordinates.
K53. Knowledge of coordinate geometry relationships (curves, points and lines).
K54. Knowledge of procedures for calculating an area.
K55. Knowledge of the California State Plane Coordinate System.

T12. Perform calculations to determine quantities of construction materials.

K56. Knowledge of methods and procedures for calculating volumes of materials.
K57. Knowledge of the purpose of mass diagrams.

D. ENGINEERNG SURVEYING OFFICE PROCEDURES (41%)

Engineering surveying office procedures include the research and planning for field surveys and the conversion of field data to an engineering format.

T13. Perform reduction of field data for plotting.

K58. Knowledge of the requirements and organization of field notes.
K59. Knowledge of procedures for plotting profiles.
K60. Knowledge of procedures for plotting cross-sections.
K61. Knowledge of procedures for plotting field points and data.
K62. Knowledge of the applications of stationing.
K63. Knowledge of the relationship between grade lines and cross-sections.

T14. Recognize information from legal boundary and easement data pertinent to engineering surveying projects.

K64. Knowledge of the U.S. Public Lands Survey System (Section, Township and Range).
K65. Knowledge of the standard formats and terminology of legal descriptions.
K66. Knowledge of the purpose of control monuments.

T15. Recognize the use of datums for horizontal and vertical control.

K67. Knowledge of different types of horizontal datums.
K68. Knowledge of different types of vertical datums.
K69. Knowledge of the purposes and types of bench marks.

T16. Prepare topographic and planimetric maps.

K70. Knowledge of contour intervals.
K71. Knowledge of methods to plot contours from field information.
K72. Knowledge of methods for interpolating contours.
K73. Knowledge of methods and procedures for aerial photogrammetric mapping.

T17. Interpret maps.

K74. Knowledge of map scales.
K75. Knowledge of units conversion.
K76. Knowledge of exaggerated scales.
K77. Knowledge of plan and profile.
K78. Knowledge of common conventions of map orientation.
K79. Knowledge of the characteristics and purposes of underground mapping.
K80. Knowledge of the characteristics and purposes of topographic mapping.
K81. Knowledge of the characteristics and purposes of grading plans.
K82. Knowledge of the characteristics and purposes of improvement plans.
K83. Knowledge of the characteristics and purposes of subdivision maps.
K84. Knowledge of the purpose of Geographic Information System (GIS).

T18. Determine physical site conditions.

K14. Knowledge of potential conflicts with underground utilities.
K85. Knowledge of Underground Services Alert.
K86. Knowledge of locating utilities.
K87. Knowledge of field investigations.

T19. Recognize laws regulating engineering surveying/limits of practice.

K88. Knowledge of the scope of practice of engineering surveying as defined by the Professional Engineers Act (in contrast to the scope of practice of land surveying as defined by the Professional Land Surveyors Act).
K89. Knowledge of the Subdivision Map Act as it pertains to the practice of engineering surveying.